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On the Orbit of β 513 = 48 Cassiopeiæ.

By T. J. J. See, A.M., Ph.D. (Berol.).

This remarkable binary was discovered by Burnham with the 18½-inch refractor at Chicago in 1878. Its place for the epoch 1880 is $\alpha = 1^{h}\ 52^{m}\ 7^{s}$; $\delta = +70^{\circ}\ 19'$; and the magnitudes of the components are 5·0 and 7·0. The star is always close, and presents the same dfficulty in dividing the components as the systems 99 Herculis, 85 Pegasi, and τ Cygni, which can be well separated only by powerful instruments in good seeing. The measures of such unequal pairs are often vitiated by sensible systematic errors, so that the computer encounters difficulty in reconciling the observations to any orbit.

The orbit herewith presented gives the general character of the motion with essential accuracy, and will be useful to observers for the next ten or fifteen years, while the companion is again receding towards apastron.

The two ends and one side of the apparent ellipse have been described. The principle of areas shows that the orbit has a rather small eccentricity, and that it is not highly inclined. I am indebted to Professor Eric Doolittle, of the Flower Observatory of the University of Pennsylvania, for the last measure, which falls exactly on the orbit here laid down. His note on the measure was, "I am certain this is real; a perfect night."

Comparison of computed with observed places for β 513.

t	θ_o	θ_c	$\theta_o-\theta_c$	ρ_o	ρ_c	$\rho_o-\rho_c$	Observer, Nights.
	°	°	°	″	″	″	
1878·70	264·5	265·1	− 0·6	1·05	0·82	+0·23	Δ, 1 ; β, 3.
1879·40	265·0	267·2	− 2·2	0·95	0·82	+0·13	OΣ, 1 ; β, 2.
1881·67	271·9	273·6	− 1·7	0·76	0·81	−0·05	β, 1.
1883·78	269·7	280·2	−10·5	1·07	0·79	+0·28	En., 5.
1885·77	284·9	286·6	1·7	...	0·76	...	HΣ, 1.
1886·03	270·1	287·6	−17·5	1·03	0·75	+0·28	T., 4.
1888·70	298·1	297·4	+ 0·7	0·83	0·70	+0·13	β, 4.
1889·52	304·4	300·9	+ 3·5	0·76	0·67	+0·09	β, 3.
1890·62	308·6	305·8	+ 2·8	0·55	0·64	−0·09	β, 4.
1891·61	313·5	310·6	+ 2·9	0·58	0·62	−0·04	β, 4.
1892·99	317·2	316·4	+ 0·8	0·5±	0·58	−0·08	Sp., 1.
1893·47	322·2	321·2	+ 1·0	0·65	0·56	+0·09	Bax., 1.
1896·09	333·7	340·2	− 6·5	0·5±	0·48	+0·02	Sp., 1.
1898·92	5·9	7·3	− 1·4	0·36	0·42	−0·06	A., 3.
1899·72	11·6	16·3	− 4·7	0·42	0·41	+0·01	A., 3–2.
1900·76	29·3	28·2	+ 1·1	0·38	0·40	−0·02	A., 1.
1904·00	65·2	67·3	− 2·1	0·40	0·40	±0·00	A., 2.
1906·32	97·4	95·5	+ 1·9	0·37	0·39	−0·02	A., 2.
1907·93	118·8	115·9	+ 2·9	<0·4	0·39	+0·01	Doo., 1.

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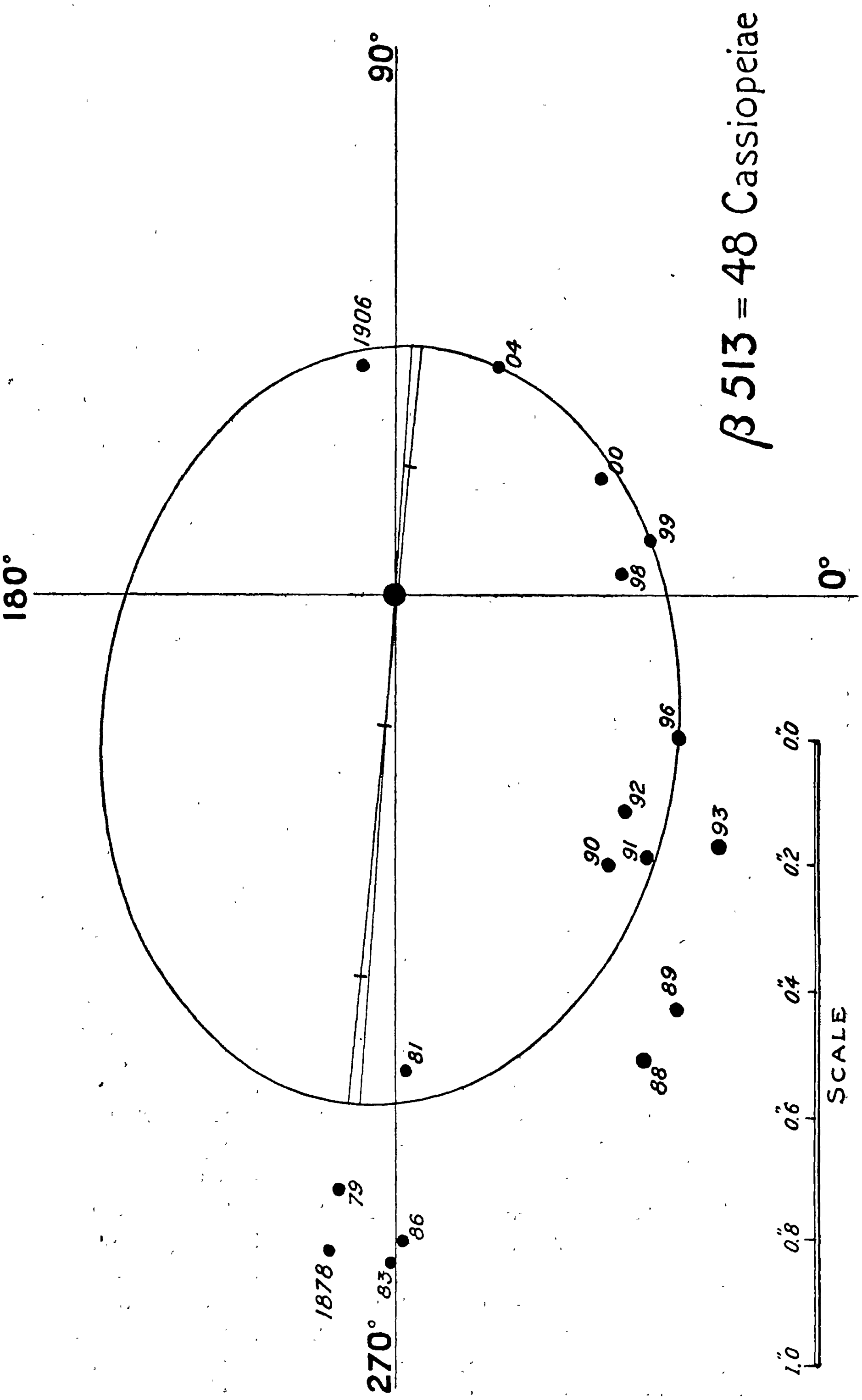

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Ephemeris.

t	θ_c	ρ_c	t	θ_c	ρ_c
	°	″		°	″
1908·60	124·3	0·38	1914·60	193·4	0·47
1909·60	137·7	0·38	1915·60	201·2	0·50
1910·60	150·5	0·39	1916·60	208·2	0·54
1911·60	163·0	0·40	1917·60	214·2	0·57
1912·60	174·4	0·42	1918·60	219·8	0·60
1913·60	184·3	0·44			

All the observations are given in Burnham's *General Catalogue of Double Stars* recently published by the Carnegie Institution. It is sufficient, therefore, to add a comparison of the computed with the observed places upon which the apparent orbit was based.

The elements of β 513 are as follows:—

P = 52·95 years
T = 1905·60
e = 0·347
a = 0″·610

Ω = 81°·4
i = 35°·9
λ = 6°·2

Apparent orbit:—

Length of major axis = 1″·214
Length of minor axis = 0″·962
Angle of major axis = 84°·7
Angle of periastron = 86°·7
Distance of star from centre = 0″·21.

For several years to come β 513 will deserve careful attention from observers with powerful telescopes. The motion will be rapid for some ten years, after which the system will widen out, so that observation will be much easier than at present.

U.S. Naval Observatory,
Mare Island, California,
1907 *December* 10.

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On the Orbit of β 552 = 11 *Orionis.*

By T. J. J. See, A.M., Ph.D. (Berol.).

This interesting binary was discovered by Burnham with the 18½-inch refractor at Chicago in 1877, but it had been previously suspected with the 6-inch in 1874 as "possibly a close pair." The place for the epoch 1880 is $\alpha = 4^{h}\ 45^{m}\ 4^{s}$; $\delta = +13^{\circ}\ 27'$; and the magnitudes are 7·0 and 10·0. It is therefore an exceedingly difficult object, and can be well seen only in the most powerful telescopes, under good conditions. On two favourable nights in 1892 Burnham could not see it with the 36-inch refractor of the Lick Observatory. Professor Hermann Struve, with the 30-inch refractor at Pulkowa, had suspected the companion on the opposite side in 1886, when the distance was only 0″·21; but as his angle corresponds to the true place at the time, I have reversed it, on the supposition that the point of the diffraction fringe noted was produced by the companion, which was then too close for separation, but might easily produce an opposite image resembling a real companion.

This system is highly inclined upon our visual ray. The components being so unequal, the observations are somewhat discordant. After a careful study of the movement, I have deduced the following elements:—

$P = 56{\cdot}0$ years
$T = 1887{\cdot}0$
$e = 0{\cdot}345$
$a = 0''{\cdot}528$

$\Omega = 4^{\circ}{\cdot}1$
$i = 56^{\circ}{\cdot}7$
$\lambda = 90^{\circ}{\cdot}2$

Apparent orbit:—

Length of major axis = 1″·00
Length of minor axis = 0″·59
Angle of major axis = 4°·2
Angle of periastron = 94°·4
Distance of star from centre = 0″·10

Comparison of computed with observed places for β 552 = 11 *Orionis.*

t	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$	Observer, Nights.
1874·95	340°±	348°·6	− 8°·6	0″·5±	0″·51	−0″·01±	β.
1877·97	360·±	359·5	+ 0·5	0·8±	0·49	+0·31±	β, 1.
1886·19	85·0 ?	74·5	+10·5	0·5±	0·21	+0·29±	H Σ, 1; angle is here reversed.
1889·19	144·7	141·2	+ 3·5	0·35±	0·25	+0·10±	Sp., 1.
1890·96	156·7	161·4	− 4·7	0·33	0·34	−0·01	β, 3.
1891·13	153·8	162·8	− 9·0	0·33	0·34	−0·01	Sp., 8.
1892·06	...	169·3	...	...	0·38	...	β, 2; apparently single with 36-inch.